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(71) Applicant(s)
Open Date Equipment Limited

(Incorporated in the United Kingdom)

Point Pleasant Works, Point Pleasant, Putney Bridge Road, London, SW18 1TU, United Kingdom

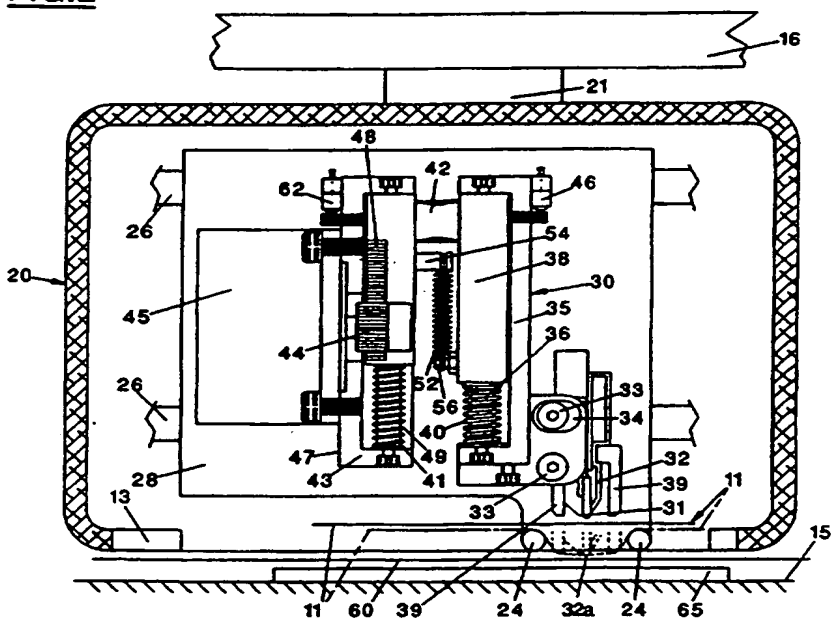
(72) Inventor(s)
Christopher Ronald Calvert

(74) Agent and/or Address for Service
E Eder & Co
39 Cranbrook Road, ILFORD, Essex, IG1 4PA, United Kingdom

(54) Thermal transfer printing apparatus having transfer material guide means

(57) A thermal printing apparatus (10) is disclosed comprising a support surface (15, 65) for a substrate (60) to be printed, and a printing device (20) including a thermal head (32) and drive means (45) to move the thermal head (32) in a direction towards the substrate support surface (15, 65). Guide means (39) are provided to guide a transfer material (11, e.g. a foil) along a path across and in contact with a printing edge (31) of the thermal head (32), the guide means (39) being disposed adjacent a level of the printing edge (31) to each side of the printing edge (31) such that the path approaches an angle of 180° with respect to the printing edge (31). The shallow path angle allows for a substantial dwell period during which the heated foil (11) remains in contact with the substrate before being stripped by bars (24).

FIG.2



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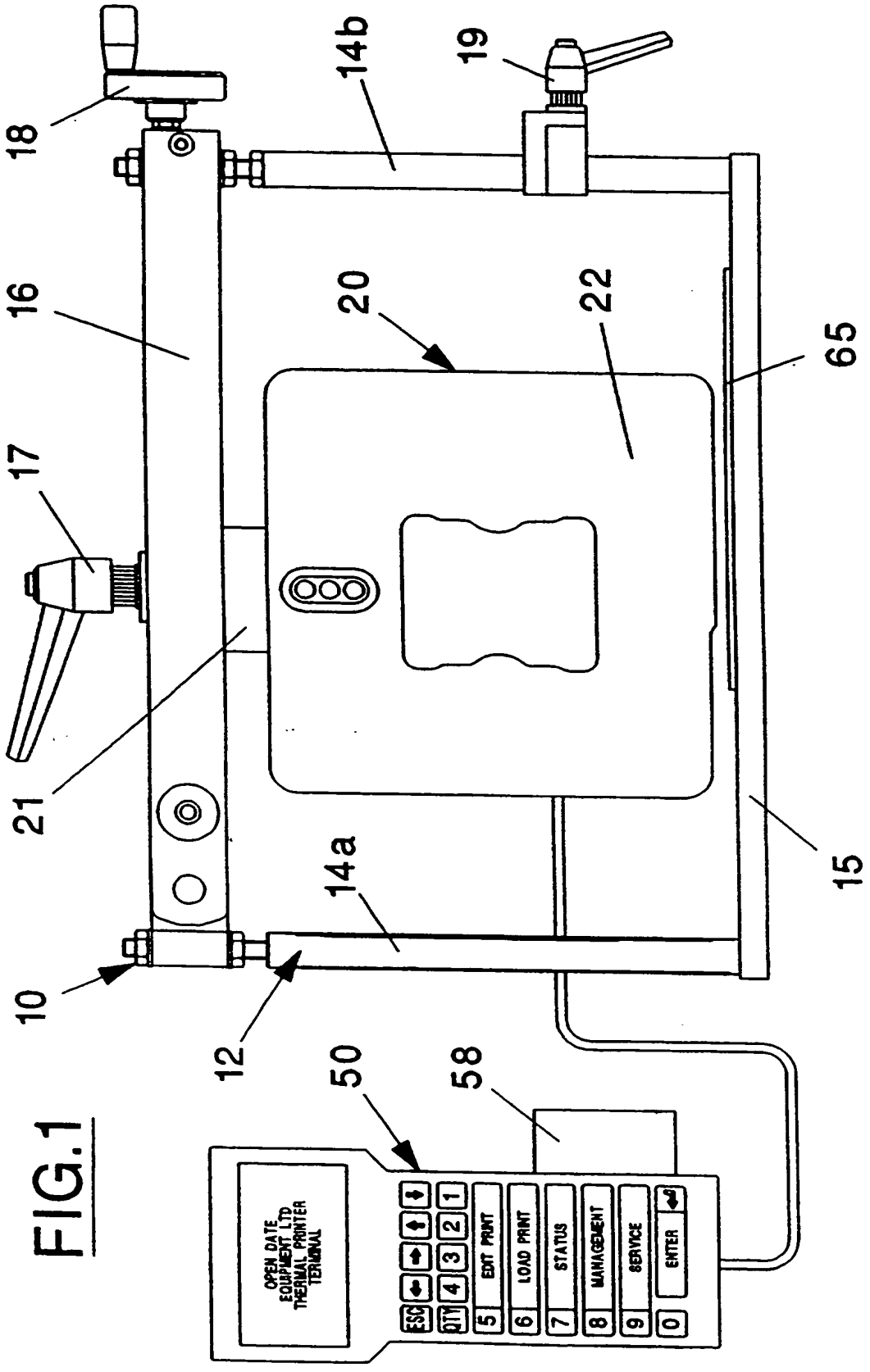
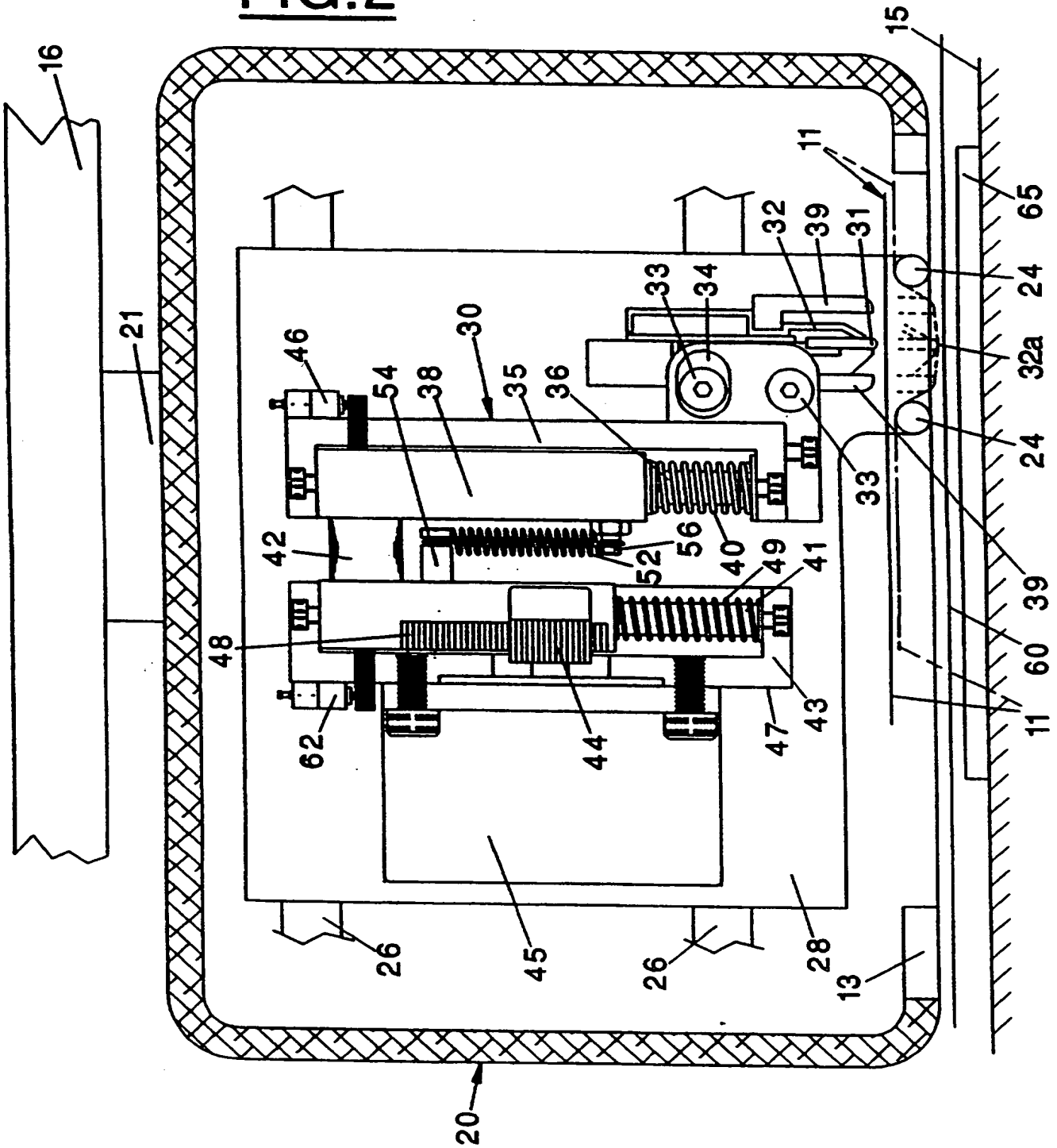


FIG.1

FIG.2



PRINTING APPARATUS

DESCRIPTION

Background to the Invention

This invention relates to printing apparatus and in particular to thermal printing apparatus. Thermal printing apparatus can effect printing by means of impression dies - as in the hot foil printing process - or by a thermal head having a linear or 2-dimensional array of thermal elements that are in use selectively energised in accord with data representative of an image to be printed, e.g. the output data from a computer, a telefax or a scanning device.

This invention is specifically concerned with thermal printing apparatus incorporating a said thermal head. The print quality provided by such a thermal printing head is highly dependent on the pressure of the thermal head upon the substrate being printed. In the past this pressure has usually been applied pneumatically or via a solenoid-operable device, and it has been difficult to vary the pressure setting to account for different qualities and/or different thicknesses of substrate to be printed.

The present invention aims to provide thermal printing apparatus incorporating a thermal head and which can overcome or at least minimise the above-mentioned and/or other difficulties of the prior art.

According to one aspect of this invention there is provided thermal printing apparatus for a hot foil printing process, the apparatus comprising a printing device including a linear printing edge comprising a row of heating elements, the thermal head being characterised by guide means for the foil to guide the foil along a path across and in contact with the printing edge, said guide means being disposed adjacent the level of the printing edge to each side of the printing edge and such that the said path approaches an angle of 180° with respect to the printing edge.

Advantageously the angle is in the range of about 170° and 179.9°.

Preferably the said guide means comprises a pair of guide bars extending parallel to the linear print head tip, one to each side of thereof and in spaced relation thereto.

Brief Description of the Drawings

By way of example one embodiment of this invention will now be described with reference to the accompanying drawings of which:

Figure 1 is a perspective view of printing apparatus according to this invention, and

Figure 2 is a diagrammatic cross-sectional view through part of the apparatus illustrated in Fig 1.

The illustrated thermal printing apparatus 10 comprises a support frame 12 having a legs 14a,14b upstanding from a base plate or platen 15, and interconnected by a cross-bar 16. Leg 14a is formed by a pair of fixed-height pillars, and leg 14b is formed as a pillar-type jack comprising a hollow tube with a threaded rod therein that is extendible

by rotation of a lever or wheel 19 engaged with the threaded rod. The cross-bar 16 is hinged to the double legs 14a and is angularly adjustable and settable in position by handwheels 18 and 19. A spindle 21 is directed downwardly, normal to and midway along the cross-bar 16. A housing 20 hangs from spindle 21 so as to be arcuately adjustable in position about the axis of spindle 21, and a rotatable clamp 17 serves to set the housing 20 in any arcuate position selected.

The front wall 22 of housing 20 serves as a closure member for the housing and carries, on its inner surface, a printing foil ribbon magazine. For this, wall 22 provides a support for a feed spool, a take-up spool and guide rollers (not shown) for the printing foil ribbon 11 (Fig 2). A pair of guide rails 26 extend horizontally between the housing's sides adjacent the rear wall of the housing. A carriage 28 is mounted on the guide rails 26 for movement therealong by a motor (not shown). The carriage 28 supports the printing device 30 which comprises inter alia a so-called "true edge" thermal printing head 32.

When the housing 20 is closed by the combined closure member and printing foil ribbon magazine 22, the ribbon 11 passes between the bottom printing edge 31 of the thermal printing head 32 and a pair of foil stripper rods 24. The latter are provided by two parallel, spaced apart, roller pins attached to the carriage 28 so as to extend transversely of the ribbon adjacent an opening 13 in the lower horizontal wall of the housing 20.

The thermal printing head 32 is mounted adjustably, by set screws 33 in arcuate slots 34, on a generally C-shaped bracket 35. Two vertical rods 36 extend in parallel betwe n the upper and lower horizontal limbs of the C-shaped bracket 35, and a block-shaped loading member 38 is slidably mounted on the vertical rods 36. A coiled

compression spring 40, of known rate characteristic, encompasses each vertical rod 36 and acts between the lower limb of C-shaped bracket 35 and the underside of loading member 38. A micro-switch 46 is mounted to operate upon relative movement between bracket 35 and loading member 38.

The loading member 38 is attached to a rack member 48 by a horizontal pivot rod 42 that interconnects the two members 38,48 adjacent their upper ends. The rack member 48 is mounted slidably on a pair of vertical guide rods 41 extending between the upper and lower horizontal limbs of C-shaped bracket 43 mounted on carriage 28. The rack member 48 is engaged by a pinion wheel 44 that is driven by an electric stepping motor 45 screw-mounted on the outer face of the bight wall 47 of the C-shaped bracket 43.

In use, the stepping motor 45 is energised by a pulsed electrical supply thereby to move pinion wheel 44 arcuately in a direction corresponding to the current direction. It will be appreciated that the extent of the arcuate movement of the pinion wheel 44 corresponds to the number of pulses with which the stepping motor 45 is energised.

The thermal head 32 is shown in full lines in Fig 2 in its out-of-use or rest position, and is shown in broken lines at 32a in its lowered, pre-print position. The head 32 has its linear printing edge 31 as a narrowly radiussed formation capable of providing a print line of 672 dots at a resolution of 11.81 dots/mm (300 dpi), and has a pair of foil guide bars 39 located one to each side of the printing edge 31 (e.g. laterally about 1 to 5 mm away) at a level closely approaching that of the printing edge 31. The level of guide bars 39 can thus be from 0.01 mm to 1 mm above the lowermost tip of printing edge 31, and in this embodiment is preferably 0.05 mm above the lowermost tip of printing edge 31.

When the print head 32 is in its raised, out-of-use or r st position, the combined closure member and printing foil ribbon magazine 22 can be mounted on the housing 20, the arrangement being such that a lowermost, horizontal length of the printing foil ribbon 11 of the magazine passes, without deflection or deformation of the foil, beneath printing edge 31 and guide bars 39 of the head 32 (and above the pair of foil stripper rods 24). When the print head is lowered to its pre-print position shown in broken lines at 32a (in a manner to be described below), the length of ribbon 11 between the stripper rods 24 is displaced by the printing edge 31 and guide bars 39 into a very shallow V-shape such that the apex of the 'V' can effect substantially line-engagement of the substrate 60 to be printed. The shallowness of the 'V' that is provided by lateral guide bars 39 enables a good print effect to be obtained even if some of the heating elements (the "dot creators") of the printing edge 31 are not perfectly colinear with the design-intended line of such heating elements (which, for example, can in practice be directed at up to 10° to the vertical plane through the horizontal axis of rounded printing edge 31).

It will be appreciated that the pair of guide bars 39 - extending parallel to the linear print head tip 31 at a level closely approaching the level of the printing edge 31, one to each side thereof and in laterally spaced relation thereto - provide foil guidance means which guide the foil 11 along a path across and in contact with the tip 31 and such that the path approaches an angle of 180° (preferably in the range of about 170° and 179.9°) with respect to the tip 31. This shallow angle allows for a substantial dwell period during which heated foil remains in contact with the substrat before being stripped by the bars 24 (see below), and hence assists in the provision of a print image of high quality.

Initially, with the thermal head in its pre-print position shown at 32a, the pinion wheel 44 is driven in a direction to move rack member 48 downwards which, by means of rod 42, moves the loading member 38 downwards. Since initially there is little or no effective resistance to downward motion of the C-shaped bracket 35, it too moves downwards with the loading member 38. However, when the thermal print head 32 engages the substrate 60 to be printed - or rather causes the intervening foil ribbon 11 to engage the substrate 60 - and urges that substrate against its support surface (provided by platen 15 or a pad 65 thereon), a resistance to further downward motion is manifested as a reaction force that acts through C-shaped bracket 35 to effect compression of the springs 40.

As soon as the springs 40 start to compress, the upper limb of C-shaped bracket 35 moves, relatively, away from the upper surface of loading member 38 and the micro-switch 46 is thereby operated, e.g. switched from ON to OFF. This signals to the control apparatus 50 to start a pre-determined count of further pulses to be supplied to the stepping motor 45.

Since the rate characteristic of the springs 40 are known, or have been predetermined during assembly of the apparatus, it is possible to regulate the restoring force of the springs 40 by compressing them by a desired amount between loading member 38 and the lower horizontal limb of C-shaped bracket member 35. This desired degree of compression is obtained by controlling the number of further electrical pulses supplied to the stepping motor 45 to produce a corresponding increment in the downward motion of rack member 48 and loading member 38, and hence in the compression of the springs 40. Thus the degree of pressure of the thermal head 32 on the substrate 60 is readily controlled to a desired value.

This contact pressure is largely independent of the thickness of the substrate and, in general, will not need adjustment when substrates of different thicknesses are to be printed. However, where substrates of different quality are supplied, it is often necessary to vary the contact pressure between the thermal head 32 and the substrate 60, and this can be readily effected by modifying the pre-determined count or number of further pulses to be provided to the stepping motor 45. It will be appreciated that this simply requires a suitable keyed input to the program controlling the control apparatus 50.

During printing, the carriage 28 carrying the printing device 30 travels linearly along the horizontal guide rails 26, and transfers the transfer medium or pigment of the thermal foil ribbon 11 onto the substrate 60 at zones corresponding to the selected heated elements of the thermal printing head 32. As the carriage 28 moves, the stripper rods 24 that it carries separate the unheated (and thus non-bonded) portions of the ribbon's transfer medium away from the substrate to leave the printed portions adhering and bonded onto the substrate.

In the illustrated preferred arrangement, the out-of-use position for the thermal head 32 is elevated a substantial distance from the substrate 60. This allows the magazine 22 to be fitted easily to the housing body without damage to the thermal head 32 or the latter possibly interfering with the printing foil ribbon of the magazine. A microswitch 62 serves as a vertical home position sensor responsive to the top vertical (rest) position of the thermal printing head 32 in which the magazine or cassette of ribbon 11 can be removed without damaging the printing head or the thermal transfer foil 11.

Ideally, the pre-print position 32a for the thermal printing head is level with the bottom of the stripper rods

24 and a small distance (e.g. 2 to 3 mm) from the surface of the foil ribbon. To obtain this pre-print position from the rest position, the control apparatus 50 is operated to supply a predetermined number of pulses to the stepping motor 45. This number of pulses is pre-set during final assembly of the apparatus to take account of manufacturing tolerances, and is programmed into the control apparatus 50. After the thermal head 32 has reached its lowered, pre-print position 32a, further lowering of the thermal head 32 to effect its printing (and return to its pre-print position 32a) is in the pressure-controlled manner indicated above in which drive to the thermal head is via the resilient means 40 (with the members 35,38 and springs 40 functioning in the manner of a lost-motion device during execution of the pre-determined increment in head travel).

The pivotal mounting (via pivot 42) of the loading member 38 to the rack member 48 permits the head 32 to print effectively and with good quality on substrates that are not fully level and it permits accommodation of planar imperfections in the substrate 60. However, to avoid a wholly-unrestricted pivotal motion of member 38, a pair of restoring springs 52 are provided in tension between studs 54,56 directed away from mutually facing surfaces of respectively the rack member 48 and the loading member 38. These restoring springs 52 serve to level the printing edge 31 of the thermal head 32.

To maintain the thermal head 32 in a raised position, out of potential danger, when the power supply to the motor 45 is switched off, a pair of light compression springs 49 are provided between the rack member 48 and the lower limb of the C-shaped bracket 43. Advantageously, these springs encompass the lower portions of the guide rods 41.

It will be appreciated that the illustrated thermal printing apparatus can be used on its own or can be

attached to a reel-fed packaging or labelling machine to provide a versatile, in line, programmable overprinting facility. The thermal head 32 can print onto a stationary web or other substrate 60 whilst moving in one or other (or both) directions as the carriage 28 moves reciprocally along the guide rails 26. The control apparatus 50 permits key pad entry - even during operation - of values for setting up or for modifying control data to the apparatus 10 and thereby reduces the time needed to change product or batch information, for example bar codes, sell-by/use-by date coding, price marking, graphics, batch expiry and/or other information (e.g. for use on pharmaceutical, food or other products) that is to be printed on flexible sheet material such as labels, films, cartons, blanks, cards and the like. The information can be downloaded directly from a computer or from a PCMCIA card 58 inserted into a slot in the hand-held key pad device 50.

Other modifications and embodiments of the invention will be readily apparent to those skilled in this art. All such modifications and embodiments are to be deemed within the ambit and scope of the invention, and the invention is not to be deemed limited to the particular embodiment(s) hereinbefore described which may be varied in construction and detail without departing from the scope of the patent monopoly hereby sought.

CLAIMS

1. Thermal printing apparatus for a hot foil printing process, the apparatus comprising a printing device including a linear printing edge comprising a row of heating elements, the thermal head being characterised by guide means for the foil to guide the foil along a path across and in contact with the printing edge, said guide means being disposed adjacent the level of the printing edge to each side of the printing edge and such that the said path approaches an angle of 180° (with respect to the printing edge).

2. Thermal printing apparatus according to Claim 1, wherein the said angle is in the range of about 170° and 179.9°.

3. Thermal printing apparatus according to Claim 1 or Claim 2, wherein the said guide means comprises a pair of guide bars extending parallel to the linear printing edge, one to each side of thereof and in spaced relation thereto.

4. Thermal printing apparatus substantially as herein described with reference to and/or as illustrated in the accompanying drawings.

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The Patent Office

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Application No: GB 9611565.4 **Examiner:** Gary Williams
Claims searched: 1-4 **Date of search:** 22 August 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B6F: FBH

Int Cl (Ed.6): B41J: 2/315,2/32,2/325

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	US 4387380	(CANON) See Figures 4 and 5, col.4,lines 8-22 and Figures 7 and 8, col.5,line 57 - col.8,line 16	1,3

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.